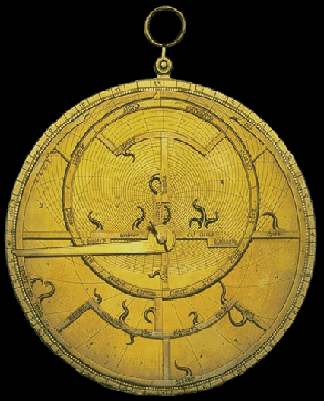
**The Astrolabe:**

***An instrument with a past and a future***

[](http://astrolabes.org/pages/fusoris.htm)

The astrolabe is a very ancient astronomical computer for solving problems relating to time and the position of the Sun and stars in the sky. Several types of astrolabes have been made. By far the most popular type is the *planispheric astrolabe*, on which the celestial sphere is projected onto the plane of the equator. A typical old astrolabe was made of brass and was about 6 inches (15 cm) in diameter, although much larger and smaller ones were made.

Astrolabes are used to show how the sky looks at a specific place at a given time. This is done by drawing the sky on the face of the astrolabe and marking it so positions in the sky are easy to find. To use an astrolabe, you adjust the moveable [**components**](http://astrolabes.org/pages/parts.htm) to a specific date and time. Once set, much of the sky, both visible and invisible, is represented on the face of the instrument. This allows a great many astronomical problems to be solved in a very visual way. [**Typical uses**](http://astrolabes.org/pages/uses.htm) of the astrolabe include finding the time during the day or night, finding the time of a celestial event such as sunrise or sunset and as a handy reference of celestial positions. Astrolabes were also one of the basic astronomy education tools in the late Middle Ages. Old instruments were also used for astrological purposes. The typical astrolabe was not a navigational instrument although an instrument called the [*mariner's astrolabe*](http://astrolabes.org/pages/mariner.htm) was widely used in the Renaissance. The mariner's astrolabe is simply a ring marked in degrees for measuring celestial altitudes.

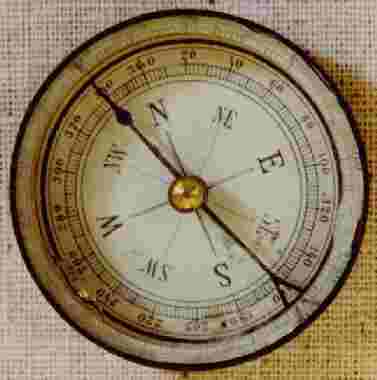
The [**history of the astrolabe**](http://astrolabes.org/pages/history.htm) begins more than two thousand years ago. The principles of the astrolabe projection were known before 150 B.C., and true astrolabes were made before A.D. 400. The astrolabe was highly developed in the Islamic world by 800 and was introduced to Europe from Islamic Spain (al-Andalus) in the early 12th century. It was the most popular astronomical instrument until about 1650, when it was replaced by more specialized and accurate instruments. Astrolabes are still appreciated for their unique capabilities and their value for astronomy education.

### The Astrolabe in Europe

The astrolabe moved with Islam through North Africa into Spain (al-Andalus) where it was introduced to European culture through Christian monasteries in northern Spain. It is likely that information about the astrolabe was available in Europe as early as the 11th century, but European usage was not widespread until the 13th and 14th centuries. The earliest astrolabes used in Europe were imported from Moslem Spain with Latin words engraved alongside the original Arabic. It is likely that European use of Arabic star names was influenced by these imported astrolabes. By the end of the 12th century there were at least a half dozen competent astrolabe treatises in Latin, and there were hundreds available only a century later. European makers extended the plate engravings to include astrological information and adapted the various timekeeping variations used in that era. Features related to Islamic prayers were not used on European instruments.

The astrolabe was widely used in Europe in the late Middle Ages and Renaissance, peaking in popularity in the 15th and 16th centuries, and was one of the basic astronomical education tools. A knowledge of astronomy was considered to be fundamental in education and skill in the use of the astrolabe was a sign of proper breeding and education. Their primary use was, however, astrological. Geoffrey Chaucer thought it was important for his son to understand how to use an astrolabe, and his 1391 treatise on the astrolabe demonstrates a high level of astronomical knowledge.

**Magnetic Compass**



A compass is an instrument containing a freely suspended magnetic element which displays the direction of the horizontal component of the Earth's magnetic field at the point of observation. The magnetic compass is an old [Chinese invention](http://www.solarnavigator.net/geography/china.htm), probably first made in China during the Qin dynasty (221-206 B.C.). Chinese fortune tellers used lodestones (a mineral composed of an iron oxide which aligns itself in a north-south direction) to construct their fortune telling boards.

**Electromagnetic Compass**

Eventually someone noticed that the lodestones were better at pointing out real directions, leading to the first compasses. They designed the compass on a square slab which had markings for the cardinal points and the constellations. The pointing needle was a lodestone spoon-shaped device, with a handle that would always point south. Magnetized needles used as direction pointers instead of the spoon-shaped lodestones appeared in the 8th century AD, again in China, and between 850 and 1050 they seem to have become common as navigational devices on ships. The first person recorded to have used the compass as a navigational aid was Zheng He (1371-1435), from the Yunnan province in China, who made seven ocean voyages between 1405 and 1433.

Compasses were common devices for travelers because they were necessary and practical items. The design of the compass did not change much between the 1600’s and the 1800’s. The compass also was known as a surveying compass or instrument, which was made by some clock makers. The surveying compass was a solar compass, which was different from the magnetic compass. Some compasses were made with wooden supports at the bottom and brass fittings on top. As with many other articles the emigrants had with them, compasses were made in New England states such as Pennsylvania (Schiffer, 352). Compasses were also imported from France and Germany.

**Pocket Compass**

The magnetic compass is the oldest instrument for navigation and has been a vital tool for navigators at sea for centuries. The compass allows ships to steer a selected course. By taking bearings of visible objects with a compass, the navigator is also able to fix a ship's position on a chart.

### Where was the compass first used?

The origin of the compass is shrouded in mystery. Certainly the Greeks knew about the attractive properties of magnetism in ancient times. Similarly, the Chinese were probably aware that an iron bar stroked with a lodestone acquired a directional north-south property as long as 2000 years ago. However, the precise date at which this knowledge was used to create the first magnetic compass is unknown. By the 10th century, the idea had been brought to Europe, probably from China, by Arab traders. Magnetic compasses of a very simple kind were certainly in use in the Mediterranean as early as the 12th century. However, early compasses were not very reliable. Although the magnetic compass was in general use in the Middle Ages, little was known about precisely how it worked.

### How does a magnetic compass work?

A magnetic compass works because the Earth is like a giant magnet, surrounded by a huge magnetic field. The Earth has two magnetic poles which lie near the North and South poles. The magnetic field of the Earth causes a magnetized 'needle' of iron or steel to swing into a north-south position if it is hung from a thread, or if it is stuck through a straw or piece of wood floating in a bowl of water.

### How were needles magnetized?

Needles were magnetized by stroking them with a lodestone, a lump of magnetic rock called magnetite. The needle did not keep its magnetism permanently, so a lodestone was carried on the ship so that the needle could be stroked whenever the magnetism wore off.

### How accurate is the magnetic compass?

As long ago as the 15th century, mariners noticed that the needle of a magnetic compass does not point accurately to Earth's true north. Columbus, for instance was aware of this on his voyages across the Atlantic in the 1490s. Instead, the needle makes an angle with true north, and that angle varies from place to place on the Earth's surface. This means that there is a different magnetic variation for different places on Earth. These variations were investigated on a famous 17th century voyage by the great scientist and astronomer Edmond Halley. It was thought at this time that the longitude of a ship could be found by the compass variation, but this proved to be untrue.

### How were the simplest compasses improved?

A great improvement came when the needle was mounted under a card on a sharp pin, and placed in a little turned wooden or ivory box.

### How were these cards marked out?

At first, compass cards were marked out not in degrees, but in points. There were 32 points, matching the directions of winds which sailors would be familiar with at sea. The four main points – North, South, East and West – are called the cardinal points.

Old compass cards are very ornamental, often covered with decoration and painted figures. All cards have the North point decorated with what is often called a fleur de lys, like the old royal symbol of France. In fact, the sign comes from a very decorated 'T' for Tramontana, the Latin word for the North wind.

### There is a lot of movement on board a ship at sea. What happens to the compass then?

To stop the needle and card from swinging wildly on board ship, even early compasses were gimbal mounted in a square box by an attachment with swivelling rings. This means that the compass is hung in a way that makes it unaffected by the movement of the ship on the sea. The remains of one such compass, housed in a special stand called a binnacle, was found in the wreck of King Henry VIII's flagship, the Mary Rose, which sank in 1546. At that time, the compass would have been lit at night by a candle.

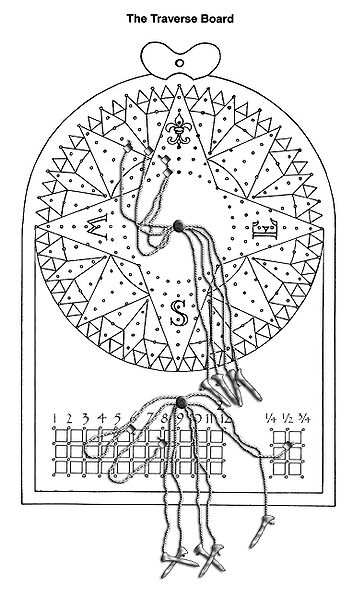
By the 19th century, the ships compass had become the familiar large, gimbal mounted instrument, enclosed in a binnacle with its own light.

**The Traverse Board**

The Traverse Board was used as a memory aid by navigators as early as the seventeenth century, and would certainly have been used by the officers and crew on the Mayflower. With this simple device they were able to record how far and in what direction they had traveled during each four-hour watch.

It consisted of a simple wooden board, equipped with pegs which were inserted into a series of holes.

The upper portion of the board was marked out in the thirty-two points of the compass. Notice there are a series of 8 holes radiating out from the center to each of the thirty-two points of the compass on the outer circle. A set of eight pegs is attached to the center of this circle.

[](http://upload.wikimedia.org/wikipedia/commons/9/92/Traverse_Board.jpg)

**USING THE TRAVERSE BOARD**

At the end of each half-hour of the watch, the officer on duty would take a peg and stick it into the hole in the compass bearing on which the ship had run during the half-hour just completed.

The first half-hour of the watch was represented by the first circle of holes nearest the center of the compass, and so on. At the end of the four-hour watch all of the pegs would have been used, with the last peg inserted in the outermost circle of holes.

To record the speed at which the ship had been traveling, the rows of holes at the bottom of the board were used. At the center of this row of holes was another set of eight pegs on strings. The holes to the left side of the center were used for the first two hours of the watch, while those on the right side were used for the last two hours.

At the end of the first half-hour of the watch, the officer in charge would insert a peg at the hole which represented the knots-per-hour at which the ship had been traveling. [Remember that this was determined by using the log-line.] If the ship had been traveling at four knots-per-hour, the officer would count over from left to right on the first row of holes and place the first peg in the fourth hole.

At the end of the four-hour watch, the officer in charge would transfer this information from the traverse board onto a slate -- or perhaps a piece of paper. At the end of the day the master or captain of the ship would use this information to write up his log, which was a detailed record of the voyage. The navigator would use the same information to chart the progress of the voyage on his maps. Traverse Boards provided a simple and relatively foolproof method of recording information which could be used even the foulest weather.

It is interesting to note that the use of the traverse board was adopted by the navigators from northern Europe and England and was used as late as the beginning of the twentieth century. No examples of traverse boards from the Mediterranean navigators has ever been found.